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DIGITAL MAPPING OF CONTOUR LINES USING SCOP IN A PRODUCTION ENVIRONMENT

W. Sonnenberg, The Hague

1. Introduction of KLM Aerocarto

KLM Aerocarto is a 100 % subsidiary of KLM Royal Dutch Airlines. The company was established exactly 60 years ago. Our market is partly in Europe, partly outside Europe.
Main projects under execution at this moment are:

In Holland: Building up data base of 80 % of the country from 1:18,000 photography to supply the government with the volume of all houses.

Outside Holland: Mapping projects
in Niger
Caribbean
Oman
Trinidad
Border-line projects UAE/Oman.

Our main production capacity consists of:
- 12 stereoplotters
- 1 fully automated rectifier
- 2 interactive graphic systems
- 12 Tektronix 4052/y
- 1 HP Computer 3000
- 1 Kongsberg flatbed plotter
- 6 aircrafts, one of which is based in the Caribbean, and one in the Middle East/Africa
- 5 doppler receivers including software
- ultramodern survey equipment.

2. Automatisation of the photogrammetric process

As in most situations there were several reasons to start automatisation of the process. Without going into detail, I shall give you the most important arguments:
- shortage of draughtsmen
- urgent need for an inhouse computer for block adjustments, geodetic adjustments and bookkeeping
- decrease of "turn around time".

A small group of staff members made a complete inventory of the existing and nearby possibilities.

With respect to the hardware, the following equipment was purchased:
- Hewlett Packard 3000
- a Tektronix 4052/y was connected to each photogrammetric plotter
- 2 Applicon I.G.S. systems
- 1 Kongsberg drawing table.

The software package was also purchased from Kongsberg.
The whole mapping process is guided by the Project Monitoring Module (Fig. 1).
A short description of the production flow is given below.

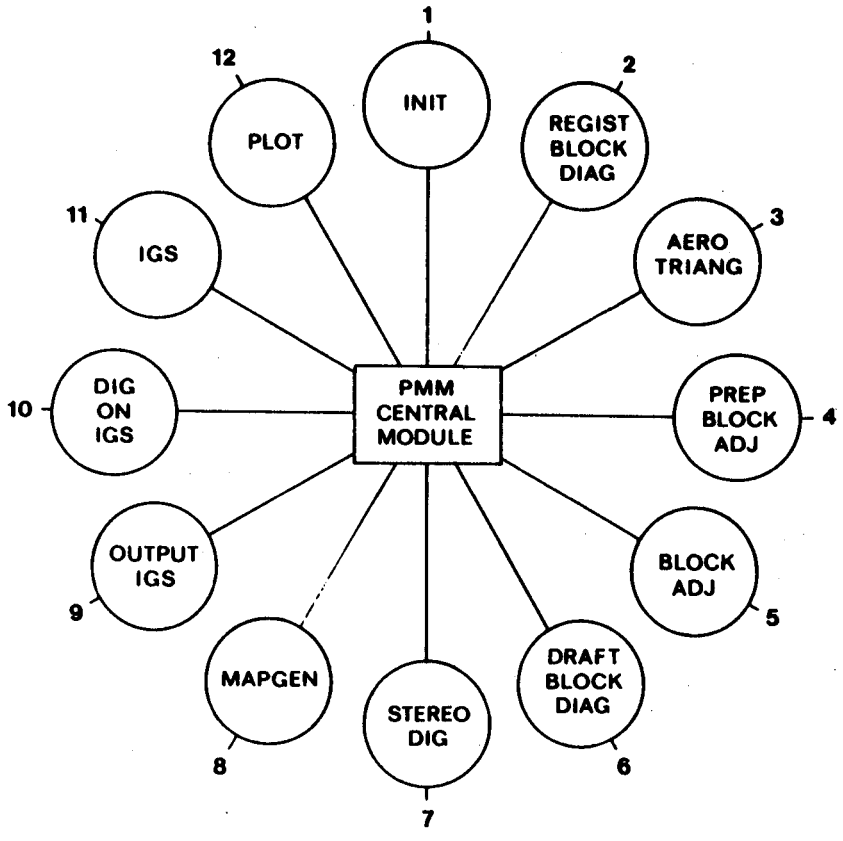

Fig. 1: Project Monitoring Module

Short Description of PMM

2.1. Initiation

A project of management file is compiled, containing:

a.) Customers' requirements
b.) Project description
c.) Catalogue of all files needed for the production. It will guide the operator in his work, warn him when he makes mistakes,and it will supervise the production according to this file.

A block reference file and a model reference file is created.

2.2. A block diagram file is registered for each block consisting of all models and all points to be measured in each model. Output is a diagfile.

2.3. Aerotriangulation

From the output of PMM 2 a guiding system is generated for the operator. He is forced to insert the instrument settings after orientation and is presented on a nearby display the points he has to measure in a proper economic sequence.

2.4. A special program converts the aerotriangulation file into a block adjustment input file and in the format needed for our PAT-M program.

2.5. The process of block adjustments is started and repeated until an acceptable result is obtained. The output of PMM 5 will result in a so-called blad-file for the mapping stage.
The operators at the stereoplotter will find a list per model of the corrected instrument settings after the block adjustments and a list of all tie- and control-points together with adjusted ground co-ordinates.

2.6. PMM 6 will create a plot file from the original diagfile and the PAT-M output to draft a block diagram at a given scale.

2.7. The PMM 7 submodule will help the operator with absolute orientation and control the storage of the digitized cartographic contents of the model. These files will be utilized in the MAPGEN system later on.

2.8. The MAPGEN module program generates controller information for an automatic drafting table. MAPGEN is based on three submodules:

MAPDIG: all details to be processed must be digitized and different types of information must be separated by an identifier or label.

MAPCON: connects and aligns the lines between different map models very accurately.

MAPPRO: processes the geographic data output into drafting instructions.

2.9. Now the output is displayed on the Interactive Graphic System and a check can be made.

2.10. New information can be added and a checkplot can be drawn.

2.11. Final editing is executed on the I.G.S. again.

2.12. The map can be produced where all levels, colours and grid sheets match together.

The system soon proved its value for aerotriangulation and topographical mapping. Problems arose during the digital mapping of contour lines.

3. SCOP

In our initial automatisation process contour lines were digitized to be stored on tape or disc.
It was there when the problems arose:

3.1. In difficult and steep terrain we needed an enormous capacity of disc space in such a way that all other users of our computer had to log off and clear their accounts for that.

3.2. If the interval between the contour lines was small or the result a rather dense pattern of lines, it became very difficult to edit those maps on our interactive graphic system; either the lines were crossing each other or the resolution of the I.G.S. was too coarse to separate certain lines.

3.3. This part in the mapping process was very time-consuming and also a special art was needed. In our investigation for existing contour line programs we did not have much choice, but SCOP seemed to fulfil our needs and more.
We bought the SCOP-B version in 1979. Although the program was still in an experimental stage and several features in our program version never came to work on our limited computer, the results were far better than our previous methods could ever give.
Calling special attention to the smoothening effect of the interpolation of grid heights by the method of linear prediction or using the theory of the least squares and the look of reality in the map by inserting breakline information.
After implementation of SCOP on our HP 3000 - in fact a minicomputer - we had a lot of problems and difficulties before everyone understood how to run the program:

a.) The choice in density of the reference points and when and where to give additional data for break- and structure-lines and when not.
b.) Formating of registrations, to make them compatible to use them in existing methods.
c.) Instruction of operators of the strict rules to handle SCOP.
d.) The right use of the many parameters and possibilities in the several program parts.
e.) The frustrations, discussions and try-outs of features in some program parts that did not run.
f.) Limitations in our computer we had to overcome, and did.
g.) The care to avoid damaging instructions for our plotter table.

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Afterwards and looking back we are glad we had these experiences. We produced several hundred maps with SCOP in Surinam at scale 1:25,000 and 1:50,000, in Abu-Dhabi at 1:10,000 and 1:50,000, and in Holland at scale 1:1,000 (for example cf. Fig. 2). We did volume calculations for merlpits and local dumps.

We can tackle any problem now and we are able to use SCOP for its purpose and beyond. Beyond, yes! We used the derived DTM from SCOP for volume calculations and some applications of profiling.

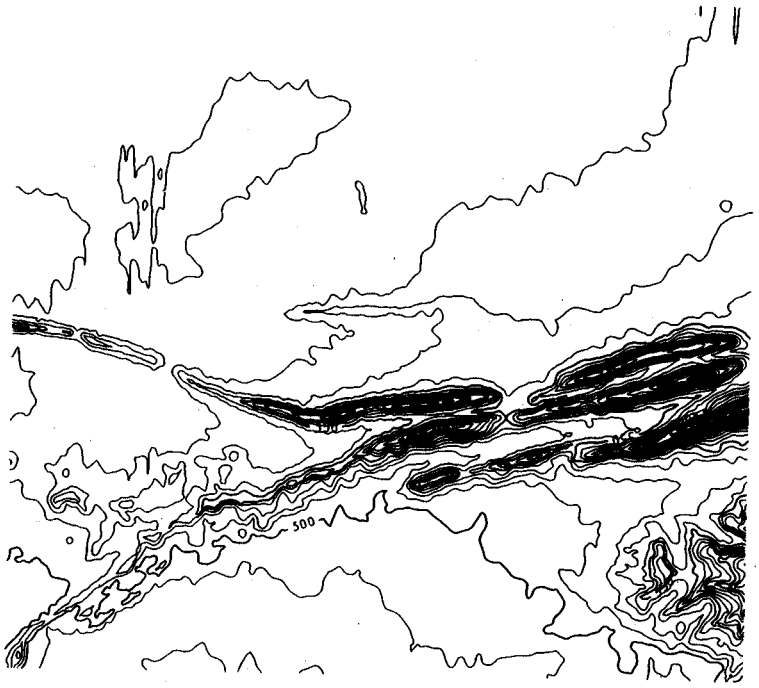

Fig. 2: Example of a map produced by SCOP

4. Special wishes for SCOP

- In part 1 to show the differences of the control points where planimetry or height, or both, were not considered in the absolute orientation.
- A better entry to part 5 to suppress several features like control points and grid crosses.
- Possibility to connect DHM 5 to compile smaller scale maps of a reasonable size.
- New parameter to increase the distance between two spot heights and to plot only one mean point.
- To insert interruptions in the contour lines where houses or other obstacles occur in the map.
- Dune landscape with many hills and holes is difficult to read. Can it be improved by arrows pointing to the holes or by inserting numbered heights to these top or most lower contour lines?
- There is a need to update plotfiles on our I.G.S., specially for terrain with flooded rice-fields and other difficult areas, rather than make changes at the input files and process again.

After having read Professor Kraus's paper most of our wishes have been answered and our problems solved. We hoped, wished and are confident now that the coming new version of SCOP will give us an easier way to the (mass) production of contour line maps and a better quality.

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Abstract

- Introduction of KLM Aerocarto, its products, markets. A short description of the history of the company will be given. Furthermore some major projects and markets will be outlined.
- The company started to automate its photogrammetric procedures in 1977. An outline will be given of the factors leading to this decision and the way in which the problems were tackled and solved.
- Experience with SCOP. A description will be given of the experiences met with all projects in which SCOP was used.
- A summary of the conclusions about the merits of SCOP in a production environment will be given.

Digitale Schichtlinienkartierung mit SCOP im Produktionsbetrieb

Zusammenfassung

- KLM Aerocarto, seine Produkte und Märkte werden vorgestellt. Es wird ein kurzer Überblick über die Unternehmensgeschichte sowie einige größere Projekte und Märkte gegeben.
- Die Firma begann 1977 mit der Automatisierung photogrammetrischer Verfahren. Der Vortrag umreißt die Faktoren, die zu diesem Entschluß führten und das Vorgehen bei der Lösung auftretender Probleme.
- Erfahrungen mit SCOP. Es wird ein Erfahrungsbericht gegeben über alle Projekte, in welchen SCOP zur Anwendung kam.
- Abschließend werden die Verdienste von SCOP in einem Produktionsunternehmen zusammenfassend dargestellt.

Dérivation numérique de courbes de niveau par le système SCOP à des fins pratiques

Résumé

- Les produits et les marchés de la maison KLM Aerocarto sont présentés. L'auteur donne un bref aperçu de l'histoire de l'entreprise et un aperçu de quelques grands projets et des marchés.
- C'est en 1977 que la maison commença à automatiser les méthodes photogrammétriques. L'exposé traite les facteurs qui étaient à la base de cette décision et la façon à résoudre d'éventuels problèmes.
- Expériences faites avec SCOP. Un compte rendu est présenté de tous les projets qui utilisent SCOP.
- En conclusion, l'auteur résume les excellents résultats obtenus avec SCOP dans une entreprise de production.

Aplicación práctica de la interpolación digital de curvas de nivel con SCOP

Resumen

- Se presenta KLM Aerocarto, sus productos y sus mercados. Se ofrece un breve resumen de la historia de la empresa así como acerca de algunos proyectos y de mercados de importancia mayor.
- En 1977, la empresa inició la automatización de los procedimientos fotogramétricos. En la conferencia, se exponen los factores que sirvieron de base a esta decisión y la forma de proceder al resolver los problemas planteados.
- Experiencias con SCOP. Se informa acerca de las experiencias hechas en todos los proyectos donde se había explicado SCOP.
- A título de conclusión se ofrece una síntesis de las ventajas que SCOP ofrece en la aplicación práctica.

Ir. W. Sonnenberg, KLM AEROCARTO b.v.,
Prinses Beatrixlaan 7, The Hague, Holland